Title: Some Like It Hot!

Link to Outcomes:

- **Problem Solving** Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers, problems which are solved in a cooperative atmosphere, and problems which are solved with the use of technology.
- **Reasoning** Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.
- **Connections** Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.
- **Measurement** Students will demonstrate and apply concepts of measurement using non-standard and standard units and metric and customary units. They will estimate and verify measurements. They will apply measurement to interdisciplinary and real-world problem solving situations.
- **Statistics** Students will demonstrate their ability to collect, organize and display data, and will interpret information obtained from displays.
- **Arithmetic Operations** Students will demonstrate their ability to solve problems using arithmetic operations with technology where appropriate.
- **Patterns/ Relationships** Students will demonstrate their ability to recognize numeric and geometric relationships and will formulate a relationship from data.
- **Concepts of Science** Students will demonstrate their acquisition and integration of major concepts and unifying themes from the life, physical, and earth/space sciences.

Brief Overview:

Students will demonstrate, in small cooperative groups and individually, the ability to measure temperature changes in water during a specified time period under various experimental conditions. Students will organize and interpret temperature measurement data using mean, median, and mode, in addition to statistical displays such as scatter plots and box plots. Using conclusions based on experimental data, students will be asked to consider a hypothetical real-life problem and provide reasonable answers. Extension questions require students to apply their understanding of experimental results to the environmental issue of the greenhouse effect and global warming.

Grade/Level:

Grade 7/8 (Math and Science)

Duration/Length:

This activity should take 4 to 5 class periods (approximately 50 minutes each).

Prerequisite Knowledge:

- Students should be able to collect and organize data.
- Students should be able to construct scatter plots and box plots.
- Students should be able to use a thermometer to measure water temperatures.
- Students should be able to use a graduated cylinder to measure a volume of water.
- Students should be able to calculate mean, median, mode, and range of data.
- Students should have a general understanding of the greenhouse effect.

Objectives:

- Students will analyze and interpret different sets of data as displayed on scatter plots and box plots.
- Students will solve a real-world problem based on their analyses of data.

Materials/Resources/Printed Materials:

- Three 250 ml beakers per group
- Three laboratory thermometers per group
- Refrigerated tap water - 600 ml per group
- One watch with second hand per group
- Transparent plastic wrap
- One 100 ml graduated cylinder per group
- One incandescent lamp with a 200 watt bulb per group
- One Activity Packet "SOME LIKE IT HOT!" per student
- One pencil and ruler per student
- One set of colored pencils per group (optional)
- One calculator per student

Development/Procedures:

Day 1:

Students will participate in a Think-Pair-Share class activity to reinforce students' understanding of the greenhouse effect and the effects of global warming on the planet Earth, relating changes in weather patterns (climate), land areas, vegetation, and ocean levels.

Day 2:

Students will complete the experimental activity "SOME LIKE IT HOT!"

- Complete prediction on Worksheet #1.

- Work in cooperative groups of four and be assigned to the following roles: Record Manager, Set up Manager, Time Manager, Activity/Task Manager.

- Measure 200 ml of refrigerated tap water into each of three 250 ml beakers.

- Cover one beaker with transparent plastic wrap (Beaker A).

- Position Beaker A and another beaker (Beaker B) at an approximate distance of 30 cm from the lamp.

- Position a third beaker (Beaker C) at a location away from the lamp.
- Place one thermometer into each of the beakers. (Use a small opening in the plastic wrap on Beaker A.)
- Record initial water temperature in each beaker (Time zero) on Worksheet #1.
- Turn on the lamp and record the water temperature in each beaker at one minute intervals for a total of ten minutes onto Worksheet #1.
- Calculate range of temperature change in each beaker and record onto Worksheet #1.

Day 3:

Students will construct a scatter plot using data from Worksheet #1.

- Construct a single X-Y axis. (Use time on X axis and temperature on Y axis.).
- Plot data points using a different symbol or color for each different beaker.
- Create a key to interpret the graph.
- Include a title and axes labels on the graph.
- Answer "Understanding the Scatter plots."

Day 4:

Students will use data gathered from all classes and provided by the teacher to complete Worksheet #3.

- List range data from all classes onto Worksheet #3 in column I for Beakers A, B, C.
- Sort range data in ascending order in column II for Beakers A, B, C.
- Find the range medians for Beakers A, B and C and record.
- Find the range modes for Beakers A, B and C and record.
- Calculate the range means for Beakers A, B and C and record.

Day 5:

Students will use sorted range data from Worksheet #3 to construct box plots for each beaker on Worksheet #4.

Evaluation:

Students can be evaluated based on the following criteria:

- Cooperative group and individual participation, accountability in assigned roles and on-task behaviors.
- Validity of data obtained in the experimental activity.

- Completeness and validity of computations and answers to questions on all worksheets.

Extension/Follow Up:

As a science extension, design and perform a second experiment identical to the first to test the effect of exposing the same volume of water (200 ml) but in a larger beaker (500 ml) to an incandescent lamp. Note and interpret any differences in data from the first experiment. (Greater surface areas of the same volume of water would warm more quickly.)

As a language arts extension, suppose you are a swimming pool construction contractor and need to write a letter of persuasion to a potential customer. Using the information gathered from the previous experiments, you want to inform the customer of recommended pool designs and use of pool covers. (A shallower pool with a greater surface area would warm more readily. A pool cover serves to trap heat from the sun's rays that pass through it due to the greenhouse effect.)

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"SOME LIKE IT HOT!"

WORKSHEET #1

Prediction: Will the temperatures of water in covered and uncovered containers respond the same to incandescent light? Yes or no? Explain your answer.

_____

_____

TIME	BEAKER A	BEAKER B	BEAKER C
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
RANGE OF DATA			

"SOME LIKE IT HOT!"

WORKSHEET #2

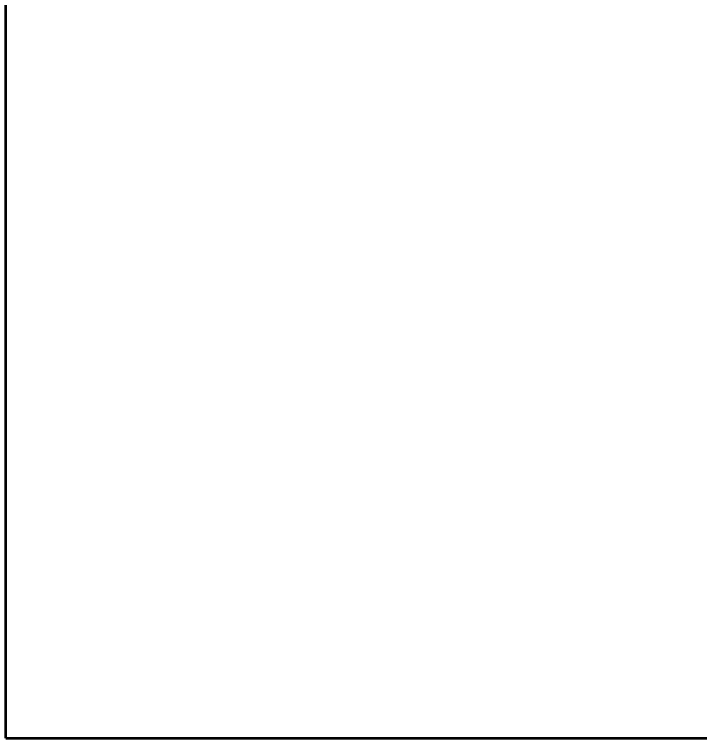
SCATTER PLOTS

KEY: BEAKER A_____

BEAKER B_____

BEAKER C_____

TITLE: _____



UNDERSTANDING THE SCATTER PLOTS:

1. Do the points for each beaker indicate a **positive**, **negative, or random** relationship?

BEAKER A _____

BEAKER B _____

BEAKER C _____

Worksheet #2 (Continued)

2. Did your prediction on Worksheet #1 agree or disagree with the observed data shown on the scatter plots?
   Yes or No? Explain your answer.

_____

_____

3. In this experiment, which beaker would best represent planet Earth? _____

   Why? _____

4. What does the plastic wrap represent? _____

5. Why is this "cover" a vital part of our planetary environment? _____

_____

6. At the end of this experiment, do you suppose the water in Beaker A and Beaker B would cool at the same rate after the lamp is turned off? Yes or No? Explain your answer.

_____

_____

“SOME LIKE IT HOT!”

WORKSHEET #3

TEMPERATURE RANGE VALUES

BEAKER	A	BEAKER	B	BEAKER
I RANGES	II SORTED RANGES	I RANGES	II SORTED RANGES	I RANGES

WORKSHEET #3 (Continued)

BEAKER A	BEAKER B	BEAKER C
MEDIAN: _____	MEDIAN: _____	MEDIAN: _____
MODE: _____	MODE: _____	MODE: _____
MEAN: _____	MEAN: _____	MEAN: _____

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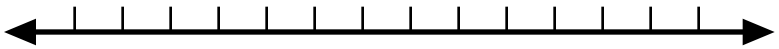
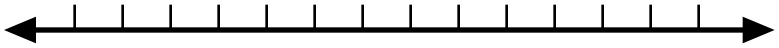
WORKSHEET #4

BOX PLOTS

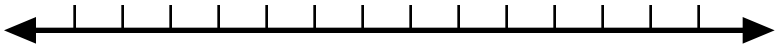
BEAKER A



BEAKER B



BEAKER C



WORKSHEET #4 (Continued)

UNDERSTANDING THE BOX PLOTS:

1. Compare and contrast the quartiles of the temperatures from Beaker A, B, and C.

_____

_____

_____

_____

2. Explain any differences you observe.

_____

_____

_____